SOME PARASITES AND HYPERPARASITES OF THE CECROPIA MOTH[1]

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When parasitic insects are bred from a lepidopterous cocoon or chrysalis, it is too often concluded that these insects are parasites of the lepidopteron, without much thought of hyperparasitism. Thus any worker interested in the specific parasitic reactions of a particular group of insects is prone to regard with suspicion reports which simply state that a certain insect is a parasite of a certain moth or butterfly.

This study was undertaken in the hope of indicating some of the possibilities that may be obtained from one of the larger moth cocoons. The writer of course realizes that a study of this kind from a limited locality, in which only the end results are examined, is far from being complete. However, it is hoped that some of these results may be suggestive. Some of this work was done at the North Dakota State College.

So far as the writer could determine, the most thorough recent work on the parasitism of the cecropia moth was done by Marsh (1934). Parts of this investigation have been published (1936) and (1937).

The cecropia moth cocoons which were used in this study were all collected at Brooklyn, New York, by Mr. J. H. Cohen of 1532 Sterling Place. During the summer of 1937, some parasites bred by Mr. Cohen were examined, so he was really responsible for the writer's initial interest in the problem. Three lots of cocoons were received from Mr. Cohen: one lot collected November 11, 1937, one collected March 19, 1938, and the third lot December 15, 1938. The first group contained 113 cocoons, most of which were supposedly parasitized. Mr. Cohen stated that in

[1] The writer wishes to express sincere appreciation to the following men for assistance in determining some of the insects mentioned in this article: Mr. C. F. W. Muesebeck, Mr. A. B. Gahan, who determined the chalcidoids; Mr. R. A. Cushman, who determined the ichneumonid, and Mr. D. G. Hall, who determined the Diptera.

procuring this material he handled 228 cocoons and determined the parasitized insects by shaking the cocoons. The second lot, which were selected for parasitic Ichneumonidæ, contained only 20 selected cocoons. In obtaining these, 250 cocoons were examined. The third group consisted of 40 cocoons, most of which were parasitized.

In most instances, a parasitized cecropia cocoon is somewhat lighter in weight than a healthy one. Parasitized cecropia larvæ, after they spin a cocoon, will in many cases become hard and dry, and break into several parts. Thus, the cocoon will rattle if it is shaken. Actual dissection of cocoons indicated that one can depend upon the "shaking test" to a very high degree in distinguishing between parasitized and healthy cocoons.

In obtaining the following results, all the cecropia cocoons were opened, and the parasites examined. The parasitic larvæ and pupæ were then placed in watch glasses in the laboratory until they emerged as adults. Since these insects were kept in the laboratory at a fairly constant temperature, they presumably emerged earlier than they would have in nature.

It has been thought best to center this discussion about several of the insects which were primary parasites of the cecropia, and which also served as hosts for some other parasite.

Pseudogaurax anchora (Lw.) (Chloropidæ)

This insect was by far the most prevalent parasite of the cecropia cocoons examined. Out of 100 cocoons upon which accurate records were kept, this dipteron occurred in 54. The larvæ occurred within all parts of the dried tissues of the host. The number of parasites present varied from only a few in some cases to 81 in one cocoon. Many of the dipterous larvæ were dead when discovered, and many were themselves parasitized. Possibly because of laboratory conditions, and because of the heavy parasitism by a small chalcidoid, only one adult specimen was obtained from the first shipment of cecropia. Several adults, however, emerged from the second and third groups. It is interesting to note that Kaston and Jenks (1937) report this same species as a parasite of spider egg cases.

The chalcidoid parasitizing the larvæ of *Pseudogaurax anchora*

has been determined by Mr. Gahan as a new species of *Pleurotropis* (Eulophidæ). This insect is an internal parasite, and is difficult to discover until the host forms a puparium, or just before the puparium is formed. The puparia, although small, may easily be dissected without injuring the parasites to any great extent, by partially burying the puparia in household cement, and allowing this to dry. Dissecting needles may then be used to pull away the puparial skin. The number of parasites found within, or emerging from, a single puparium, varied from 2 to 10.

Achætoneura samiæ Web. (Tachinidæ)

This insect occurred occasionally, as a primary parasite, within all three lots of cocoons, and several adult specimens were reared. In addition, a single specimen of *Sarcophaga misera* var. *sarracenioides* Ald. (Sarcophagidæ) emerged. A large number of dipterous puparia were found which varied somewhat in size and coloration. Since many of these did not emerge as adults, the writer could not determine to his entire satisfaction that these were all of the same species. It is thought probable, however, that most of these puparia were those of *Achætoneura samiæ*, since only a single specimen of any other large dipteron was obtained. But the possibility that other species might have been represented should not be overlooked. From the first lot of cocoons, only 19 out of 100 cocoons were parasitized, or showed signs of having been parasitized, by a large dipteron. The parasitized cecropia in some instances had formed a pupa within the cocoon before dying. In a few cases, the parasites had emerged from the host and formed puparia loose in the cocoon; in other cases, puparia were formed within the body of the host.

Several of the dipterous puparia were parasitized. Within one puparium, 22 chalcidoid pupæ were found, and several other dissected puparia yielded additional parasites. In addition, many of these insects emerged in the breeding bags. This parasite proved to be *Dimmockia incongruus* Ashm. (Eulophidæ). All these insects were in the pupal stage, and some of these pupæ were likewise parasitized. Within the pupal skin of some of these insects were the larvæ or pupæ of *Pleurotropis tarsalis* (Ashm.). Normal pupæ of *D. incongruus* were of a uniform glossy black

color, but the parasitized pupæ were brownish, and the pupal skin was broken in many cases. *Pleurotropis tarsalis* was thus in this instance a tertiary parasite.

Spilocryptus extrematus Cress. (Ichneumonidæ)

From the first lot of cecropia cocoons examined, only a single cocoon was parasitized by this ichneumonid. Within this one cocoon, however, there were 54 cocoons of this parasite, all of which were still in the larval stage when they were examined January 6. None of these ichneumonids was parasitized.

The second lot of cecropia, however, had been collected specifically for this parasite in a somewhat different region, and some of the cocoons had been opened in order to determine definitely the nature of parasitism. Thus, in the second lot, there were 12 cocoons, out of the 20 received, which were parasitized by *Spilocryptus extrematus* Cress. Two species of chalcidoid parasites were parasitic upon ichneumonids from 6 of these 12 parasitized cecropia cocoons. These insects were *Dibrachys cavus* (Walk.) (Pteromatidæ), and *Monodontomerus* sp., (F) (Callimomidæ).

The pteromalids were present within two of the cecropia cocoons, and at the time of dissection, March 31, these insects were in the pupal stage. Possibly because of the warm laboratory temperature, these insects emerged a few days later as adults. Females oviposited readily into living ichneumonid larvae.

Monodontomerus sp., was obtained from 4 of the parasitized cecropia cocoons. Presumably these insects were external parasites of *Spilocryptus extrematus,* and at the time of dissection, March 30, occurred in both the larval and pupal stages. The parasites were loose in the ichneumonid cocoon, and in most instances the shriveled-up larva of the host was still present.

In the laboratory, the females did not show particular interest in cocoons or naked larvæ of *Spilocryptus extrematus,* and no attempt was made to oviposit. When, however, a cecropia cocoon containing ichneumonid cocoons was placed with the females, several attempts were made to oviposit through the cecropia cocoon. One female also crawled into the cocoon and stayed several minutes. Whether or not oviposition occurred is not known.

It would seem, however, that in this case, the combination of the cecropia cocoon plus the ichneumonid cocoons, was a stronger stimulus to oviposition than the ichneumonid larvæ or cocoons alone.

It is thought probable that the females of *Monodontomerus* sp., since these insects possess a comparatively short ovipositor, crawl through the valve of the cecropia cocoon, and oviposit directly into the cocoon of their host. In all cases of parasitism examined, the callimomids were inside the host cocoon. Only a few of the total ichneumonid cocoons were parasitized.

MULTIPLE PARASITISM

In a few cases, cecropia cocoons contained several types of parasites. One cocoon was of particular interest. Within this cocoon were several cocoons of *Spilocryptus extrematus,* all insects of which were in the pupal stage. In addition there were several larvæ of *Pseudogaurax anchora,* and some large dipterous puparia. Within two of these dipterous puparia were pupæ of *Dimmockia incongruus,* and some of these in turn were parasitized by *Pleurotropis tarsalis.* This cecropia had, therefore, directly or indirectly, supported insects of 5 species. It is probable that under normal conditions most of these insects would have emerged as adults. But in this particular case, there was a hole in the cocoon, indicating that a bird had enjoyed a meal at the expense of the enclosed occupants. Consequently several of these insects were dead.

I believe this study emphasizes the fact that parasitic populations of a given host may vary considerably from locality to locality and even may vary in regions of the same locality. Marsh (1934), in a study of cecropia cocoons collected in the vicinity of Chicago, reared 9 species of parasitic insects. Of the 9 species reared by the writer, only three, *Dimmockia incongruus, Spilocryptus extrematus,* and *Pleurotropis tarsalis,* were identical with species obtained by Marsh. In the Chicago area, Marsh discovered that *Spilocryptus extrematus* was the principal primary parasite of the cecropia. In the present study, the principal primary parasite was *Pseudogaurax anchora,* and parasitism by *Spilocryptus extrematus* was extremely limited.

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